Lei Wang

Curriculum Vitae

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Personal data

Day of Birth	1st December 1983	Place of Birth	Nanjing
Sex	Male	Nationality	China
Researcher ID	B-1787-2010	Erdős Number	2 (through Gergely Harcos)

Academic Positions

2016.3– Present **Assistant Professor**, *Institute of Physics, Chinese Academy of Sciences*, Beijing, China.

2015.6 – 2016.2 **Senior research assistant (Oberassistent I)**, *ETH*, Zurich, Switzerland.

2011.9 – 2015.5 **Postdoctoral research assistant**, *ETH*, Zurich, Switzerland.
Supervisor: Prof. Dr. Matthias Troyer

Education

2006.9– 2011.7 **PhD in Physics**, *Institute of Physics, Chinese Academy of Sciences*, Beijing, China.
Supervisors: Prof. Xincheng Xie and Prof. Xi Dai

2002.9– 2006.6 **BSc in Physics**, *Nanjing University*, Nanjing, China.

Interests

Algorithmic Design: Design new efficient algorithms for strongly correlated quantum matter

Machine Intelligence: Computational intelligence and its application in scientific discoveries

Ultracold Atoms: Study topological phases and non-equilibrium dynamics in ultracold atomic gases

Skills

Numerical methods: Density functional theory, exact diagonalization, variational and quantum Monte Carlo methods, Gutzwiller approach, matrix product state methods and dynamical mean field theory.

Programming languages: Large scale high performance computing with C++, Python and Fortran.

Awards

2009–2010 **Director's scholarship**, *Institute of Physics.*

2009–2010 **Excellent student awards**, *Graduate School of Chinese Academy of Sciences.*

2003–2006 **Renmin scholarship**, *Nanjing University.*

Publications

[1] **Lei Wang**, Xi Dai, Shu Chen, and X. C. Xie. *Magnetism of cold fermionic atoms on the p band of an optical lattice.* Phys. Rev. A **78**, 023603 (2008).

[2] XiaoYu Deng, **Lei Wang**, Xi Dai, and Zhong Fang. *Local density approximation combined with Gutzwiller method for correlated electron systems: Formalism and applications.* Phys. Rev. B **79**, 075114 (2009).

[3] Jia Ning Zhuang, **Lei Wang**, Zhong Fang, and Xi Dai. *Fast impurity solver based on Gutzwiller variational approach.* Phys. Rev. B **79**, 165114 (2009).

[4] Hua Jiang, **Lei Wang**, Qing-feng Sun, and X. C. Xie. *Numerical study of the topological anderson insulator in HgTe/CdTe quantum wells.* Phys. Rev. B **80**, 165316 (2009).

[5] **Lei Wang**, Hua Jiang, J. N. Zhuang, Xi Dai, and X. C. Xie. *Spin current through an ESR quantum dot: A real-time study.* Phys. Rev. B **81**, 075323 (2010).

[6] Zi Cai, **Lei Wang**, X. C. Xie, and Yupeng Wang. *Interaction-induced anomalous transport behavior in one-dimensional optical lattices.* Phys. Rev. A **81**, 043602 (2010).

[7] Jian-Qing Qi, **Lei Wang**, and Xi Dai. *Antiferromagnetism of repulsively interacting fermions in a harmonic trap.* Chinese Physics Letters **27**, 083102 (2010).

[8] Zi Cai, **Lei Wang**, X. C. Xie, U. Schollwöck, X. R. Wang, M. Di Ventra, and Yupeng Wang. Quantum spinon oscillations in a finite one-dimensional transverse Ising model. Phys. Rev. B **83**, 155119 (2011).

[9] **Lei Wang**, Xi Dai, and X. C. Xie. *Frequency domain winding number and interaction effect on topological insulators.* Phys. Rev. B **84**, 205116 (2011).

[10] **Lei Wang**, Hua Jiang, Xi Dai, and X. C. Xie. *Pole expansion of self-energy and interaction effect for topological insulators.* Phys. Rev. B **85**, 235135 (2012).

[11] **Lei Wang**, Xi Dai, and X. C. Xie. *Interaction-induced topological phase transition in the Bernevig-Hughes-Zhang model.* Europhysics Letter **98**, 57001 (2012).

[12] Thomas Uehlinger, Daniel Greif, Gregor Jotzu, Leticia Tarruell, Tilman Esslinger, **Lei Wang** and Matthias Troyer. *Double transfer through Dirac points in a tunable honeycomb optical lattice.* Eur. Phys. J. Special Topics, **217**, 121 (2013). (Cover image)

[13] Hsiang-Hsuan Hung, **Lei Wang**, Zheng-Cheng Gu and Gregory A. Fiete. *Topological phase transition in a generalized Kane-Mele-Hubbard model: A combined Quantum Monte Carlo and Green's function study.* Phys. Rev. B **87**, 121113(R) (2013).

[14] **Lei Wang**, Alexey A. Soluyanov and Matthias Troyer. *Proposal for direct measurement of topological invariants in optical lattices.* Phys. Rev. Lett **110**, 166802 (2013).

[15] Zi Cai, Hsiang-Hsuan Hung, **Lei Wang**, Dong Zheng and Congjun Wu. *Pomeranchuk cooling of the SU(2N) ultra-cold fermions in optical lattices.* Phys. Rev. Lett **110**, 220401 (2013).

[16] **Lei Wang**, Matthias Troyer and Xi Dai. *Topological charge pumping in a one-dimensional optical lattice.* Phys. Rev. Lett **111**, 026802 (2013).

[17] Zi Cai, Hsiang-Hsuan Hung, **Lei Wang** and Congjun Wu. *Quantum magnetic properties of the SU(2N) Hubbard model in the square lattice: a quantum Monte Carlo study.* Phys. Rev. B **88**, 125108 (2013).

[18] **Lei Wang** and Matthias Troyer. *Seeing Hofstadter's Butterfly in Atomic Fermi Gases.* Phys. Rev. A **89**, 011603(R) (2014).

[19] Jakub Imriška, Mauro Iazzi, **Lei Wang**, Emanuel Gull, Daniel Greif, Thomas Uehlinger, Gregor Jotzu, Leticia Tarruell, Tilman Esslinger and Matthias Troyer. *Thermodynamics and magnetic properties of the anisotropic 3D Hubbard model*, Phys. Rev. Lett **112**, 115301 (2014).

[20] Hsiang-Hsuan Hung, Victor Chua, **Lei Wang** and Gregory A. Fiete. *Finite-size and interaction effects on topological phase transitions via numerically exact quantum Monte Carlo calculations*, Phys. Rev. B **89**, 235104 (2014).

[21] **Lei Wang** and Matthias Troyer. *Renyi Entanglement Entropy of Interacting Fermions Calculated Using Continuous-Time Quantum Monte Carlo Method*, Phys. Rev. Lett. **113**, 110401 (2014).

[22] **Lei Wang**, Philippe Corboz and Matthias Troyer. *Fermionic Quantum Critical Point of Spinless Fermions on a Honeycomb Lattice*, New J. of Phys., **16**, 103008 (2014), selected by the Editors for IOPselect.

[23] **Lei Wang**, Hsiang-Hsuan Hung and Matthias Troyer. *Topological Phase Transition in the Hofstadter-Hubbard Model*, Phys. Rev. B **90**, 205111 (2014).

[24] **Lei Wang**, Mauro Iazzi, Philippe Corboz and Matthias Troyer. *Efficient Continuous-time Quantum Monte Carlo Method for the Ground State of Correlated Fermions*, Phys. Rev. B **91**, 235151 (2015), Editors' suggestion.

[25] **Lei Wang**, Ye-Hua Liu, Jakub Imriška, Ping Nang Ma, Matthias Troyer. *Fidelity susceptibility made simple: A unified quantum Monte Carlo approach*, Phys. Rev. X **5**, 031007 (2015).

[26] **Lei Wang**, Hiroshi Shinaoka, Matthias Troyer. *Fidelity Susceptibility Perspective on the Kondo Effect and Impurity Quantum Phase Transitions*, Phys. Rev. Lett. **115**, 236601 (2015).

[27] Ye-Hua Liu and **Lei Wang**. *Quantum Monte Carlo study of mass-imbalanced Hubbard models*, Phys. Rev. B **92**, 235129 (2015), Editors' suggestion.

[28] **Lei Wang**, Ye-Hua Liu, Mauro Iazzi, Matthias Troyer, Gergely Harcos. *Split orthogonal group: A guiding principle for sign-problem-free fermionic simulations*, Phys. Rev. Lett. **115**, 250601 (2015).

[29] Shuta Nakajima, Takafumi Tomita, Shintaro Taie, Tomohiro Ichinose, Hideki Ozawa, **Lei Wang**, Matthias Troyer, Yoshiro Takahashi. *Topological Thouless Pumping of Ultracold Fermions*, Nature Physics **12**, 296 (2016).

[30] **Lei Wang**, Ye-Hua Liu and Matthias Troyer. *Stochastic series expansion simulation of the t-V model*, Phys. Rev. B **93**, 155117 (2016).

[31] Jakub Imriška, **Lei Wang**, Matthias Troyer. *First order topological phase transition of the Haldane–Hubbard model*, Phys. Rev. B **94**, 035109 (2016).

[32] Ilia Zintchenko, **Lei Wang** and Matthias Troyer. *Ferromagnetism of the Repulsive Atomic Fermi Gas: three-body recombination and domain formation*, Eur. Phys. J. B **89**, 180 (2016)

[33] **Lei Wang**, *Discovering Phase Transitions with Unsupervised Learning*, Phys. Rev. B **94**, 195105 (2016)

[34] Li Huang, Yilin Wang, **Lei Wang**, Philipp Werner, *Detecting phase transitions and crossovers in Hubbard models using the fidelity susceptibility*, Phys. Rev. B **94**, 235110 (2016)

[35] Li Huang, **Lei Wang**. *Accelerate Monte Carlo Simulations with Restricted Boltzmann Machines*, Phys. Rev. B **95**, 035105 (2017)

[36] Li Huang, Yi-feng Yang, **Lei Wang**, *Recommender Engine for Continuous Time Quantum Monte Carlo Methods*, Phys. Rev. E 95, 031301(R) (2017)

[37] Jan Gukelberger, **Lei Wang**, and Lode Pollet, *Ising Antiferromagnet in the 2D Hubbard Model with Mismatched Fermi Surfaces*, Phys. Rev. B 95, 205121 (2017)

Eprints on arxiv

`http://arxiv.org/a/wang_l_1`

[1] Zi Cai, **Lei Wang**, Jian Li, Shu Chen, X. C. Xie and Yupeng Wang. *D-wave bosonic pair in an optical lattice*, arXiv:0910.0508

[2] **Lei Wang**, Jia-Ning Zhuang, Xi Dai and X. C. Xie. *An Impurity Solver Using the Time-Dependent Variational Matrix Product State Approach*, arXiv: 1001.2943

[3] **Lei Wang**, Hao Shi, Shiwei Zhang, Xiaoqun Wang, Xi Dai and X. C. Xie. *Charge-density-wave and topological transitions in interacting Haldane model*, arXiv:1012.5163

[4] **Lei Wang**, Troels F. Rønnow, Sergio Boixo, Sergei V. Isakov, Zhihui Wang, David Wecker, Daniel A. Lidar, John M. Martinis and Matthias Troyer. *Comment on: "Classical signature of quantum annealing"* , arXiv:1305.5837

[5] Bela Bauer, **Lei Wang**, Iztok Pižorn, Matthias Troyer. *Entanglement as a resource in adiabatic quantum optimization*, arXiv:1501.06914

[6] Jing Chen, Song Cheng, Haidong Xie, **Lei Wang**, and Tao Xiang,*On the Equivalence of Restricted Boltzmann Machines and Tensor Network States*, arXiv:1701.04831

[7] **Lei Wang**, *Can Boltzmann Machines Discover Cluster Updates ?* arXiv:1702.08586

[8] Wei Tang, Lei Chen, Wei Li, X. C. Xie, Hong-Hao Tu, **Lei Wang**, *Universal Boundary Entropies in Conformal Field Theory: A Quantum Monte Carlo Study* arXiv:1708.04022

[9] Lei Chen, Hao-Xin Wang, **Lei Wang**, Wei Li, *Conformal Thermal Tensor Network and Universal Entropy on Topological Manifolds* arXiv:1708.04034

Selected Talks

Oct 2008 **Mott Physics and Magnetism in the Optical Lattice**, *Oklahoma State University physics department seminar*, Stillwater, USA.

Aug 2009 **Variational Matrix Product State Approach as an Impurity Solver**, *The Sixth Joint Meeting of Chinese Physicists Worldwide (OCPA6)*, Lanzhou, China.

Jan 2010 **Time evolution algorithm based on Monte Carlo Method**, *KITPC seminar*, Beijing, China.

Sep 2010 **Time evolution of quantum many-body systems: A game of life, death and birth in Slater determinant space**, *2010 Annual Meeting of Chinese Physical Society*, Tianjin, China.

Aug 2011 **Interaction effect on topological insulator: studies based on interacting Greens functions**, *Workshop on Emergence in Field Theory*, Nanyang Technological University, Singapore.

Feb 2012 **Density functional theory for static and dynamical properties of cold atomic gases**, *2nd NCCR QSIT General Meeting*, Arosa, Switzerland.

June 2012 **Density functional theory for static and dynamical properties of cold atomic gases**, *Quantum Systems and Technology*, Monte Verita, Switzerland.

Aug 2012 **Density functional theory for static and dynamical properties of cold atomic gases**, *The 6th national conference on cold atom physics and quantum information for young researchers*, Jinhua, China.

Jan 2013 **Topological charge pumping of cold atoms**, *Workshop on orbital physics in cold atom systems*, IOP Beijing, China.

Feb 2013 **Simulating dynamics and topological phases of cold fermionic gases**, *Finite-temperature non-equilibrium superfluid systems*, Queenstown, New Zealand.

June 2013 **Topological charge pumping of cold atoms**, *Topological Phases in Condensed Matter and Cold Atom Systems: towards quantum computations*, Cargese, France.

Aug 2013 **Topological charge pumping of cold atoms**, *The 7th national conference on cold atom physics and quantum information for young researchers*, Tunxi, China.

May 2014 **Spinless fermions on a honeycomb lattice: from quantum criticality to topological superconductors**, *KITPC Program on Precision Many-body Physics of Strongly correlated Quantum Matter*, KITPC Beijing, China.

Feb 2015 **Surprises in simulation of quantum phase transitions**, *Workshop on Quantum Simulations*, Benasque, Spain.

April 2015 **Simulation of Hubbard Models in the Era of Synthetic Gauge Field**, *CECAM Workshop on Computational Many-Body Physics in the Era of Artificial Gauge Fields*, LMU, Germany.

October 2015 **Recent progresses on diagrammatic determinantal approach of lattice fermions**, *Advances in Diagrammatic Monte Carlo Methods for Quantum Field Theory Calculations in Nuclear, Particle, and Condensed Matter Physics*, ECT* Trento, Italy.

April 23, 2016 **New Adventures in Quantum Monte Carlo Method - How Did I Earn an Erdős Number of Two?**, *The 6th Workshop on Quantum Many-Body Computation*, Beijing Computational Science Research Center, China.

June 30, 2016 **Simulation of Hubbard Models in the Era of Synthetic Gauge Field**, *2016 Hangzhou Symposium on Degenerate Fermi Gases*, Zhejiang University, China.

July 18, 2016 **Simulation of Hubbard Models in the Era of Synthetic Gauge Field**, *The 10th national conference on cold atom physics for young researchers*, Wuhan, China.

September 4, 2016 **Machine Learning for Many-body Physics**, *2016 CPS Fall Meeting*, Beijing, China.

December 13, 2016 **Machine Learning for Many-body Physics**, *Fourth Workshop on Tensor Network States-Algorithms and Applications*, Hsinchu, Taiwan.

December 24, 2016 **Machine Learning for Many-body Physics**, *Mini-workshop on computational physics*, Dali, China.

March 21, 2017 **Can Machine Learning Teach Us Cluster Updates ?**, *SIGN 2017: International Workshop on the Sign Problem in QCD and Beyond*, INT Seattle, USA.

July 19, 2017 **Machine Learning for Many-body Physics**, *Fourth National Conference on Statistical Physics and Complex Systems*, Xiaan, China.

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